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ANNUAL REVIEW

CHEMICAL & LIFE SCIENCE ENGINEERING

VCU College of Engineering

Jocelyn Trapp (left) and Christina Tang, Ph.D., were part of a multidisciplinary team of faculty and students constructing fibers using different materials and methods, like electrospinning.

CHEMICAL AND LIFE SCIENCE ENGINEERING UNDERGRADUATES FOLLOW RESEARCH PASSIONS, CO-AUTHORING PAPER ON ELECTROSPINNING TECHNIQUES

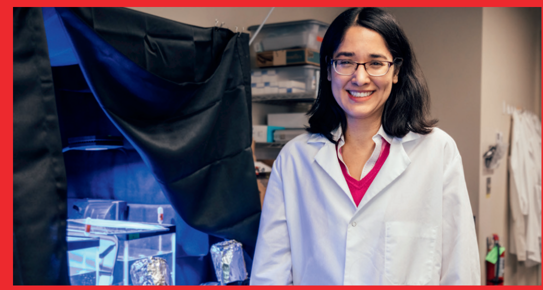
Undergraduate research is a critical resource for established labs. Students with fresh ideas infuse new creativity into the questions researchers are attempting to answer. **Christina Tang, Ph.D.**, associate professor of chemical and life science engineering, encourages students to get involved early in their academic careers.

Tang's lab recently explored different collector plate implementations in order to create functional 2D and 3D shapes from a single-step electrospinning process. Undergraduate students Jocelyn Trapp, Ioana Caloian and Ryan A. Kim worked alongside Tang and her graduate students.

Tang's research is part of a multidisciplinary team of arts, business and engineering faculty and students. The goal was to construct fibers using different methods and materials in a collaborative project between the VCU College of Engineering and VCU School of the Arts. Funding for the initiative was made possible, in part, through Tang's National Science Foundation CAREER award for Directed Self-Assembly of Multifunctional Polymer Nanoreactors for Sustainable Chemical Manufacturing.

In their experiments, Tang's lab uses a charged mesh collector plate to control how fibers deposit themselves when the solution jet evaporates and nanofiber material is formed. Material gathers more densely around the mesh structure and not the gaps between, creating a template the fibers build around. Variations in the mesh size and electric charge influence the patterning and thickness of the nanofibers.

Creating disposable items like surgical masks or shoe covers for clean rooms on demand using electrospinning with an electrically-charged mesh is one application of this technology. Rapid fabrication like this can also be applied to filtration, tissue engineering, drug delivery and electronics.



RESEARCHERS SEEK TO APPLY NANOPARTICLE DRUG DELIVERY TO CORAL WOUND HEALING

Researchers like **Nastassja Lewinski, Ph.D.**, associate professor of chemical and life science engineering, are working to understand how corals heal in order to aid the restoration of these fragile ecosystems. They also seek partnerships with stakeholders that can support coral preservation by applying this research to industry practices and providing funding for continued research.

Discovering the limits of coral healing is part of Lewinski's work. Ideal water temperature for coral is 25 degrees Celsius, so research is conducted at the ideal temperature and elevated temperatures of 28 to 31 degrees Celsius, the projected water temperatures influenced by global warming.

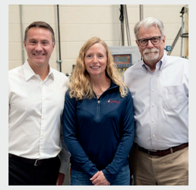
"We're looking to understand the mechanics of healing," Lewinski said, "Some of what we've found suggests a process similar to human healing. We want to understand the actors in this process at a cellular level and what their role is in repairing tissue."

These observations inform the mathematical, cell-based wound healing model developed by Lewinski's collaborators. Similar to humans, corals have been documented as following the same four stages of the healing process: 1) coagulation to close the site of injury, 2) infiltration with immune cells to ward off infection, 3) cell migration and proliferation and 4) scar remodeling.

Nutritional variables are also being considered within the experiment. Corals derive energy from consuming small organisms and their symbiotic relationship with algae colonies. Modifying nutritional balance in the lab emulates the coral's participation in the food web, where accessibility to vital nutrients could impact healing.

Developing a nanoparticle drug-delivery system designed to deliver molecules to speed wound healing is the culmination of this research. Lewinski hypothesizes the delivery system would promote an energy-burning state within the corals that could result in increased healing.

PRIVATE-PUBLIC SECTOR COLLABORATION AIMS TO SUPPORT THE NEXT GENERATION OF CHEMICAL ENGINEERS



ChemTreat expanded its longstanding partnership with the VCU College of Engineering to co-lecture a course on Water Essentials, teaching the fundamentals of industrial water treatment and its vital importance for environmental sustainability.

This specialized course provided aspiring chemical and life science engineers a unique opportunity to learn from real-life water treatment applications. A variety of technical experts from ChemTreat with decades of combined experience served as guest lecturers.

The course, led by Professor and Associate Chair of the Department of Chemical and Life Science Engineering **James K. Ferri, Ph.D.**, covers topics ranging from natural water sources and pretreatment to microbiological monitoring and sustainability practices. It examined the most important water applications, covering water chemistry and its impact on critical industrial processes including steam generation, heat exchanger and steam condenser cooling, high-purity water production and wastewater treatment.

Ferri said of the partnership, "Working with the industry-leading technical experts at ChemTreat has been a very rewarding experience. The breadth of perspective and experience of the ChemTreat technical experts is invaluable to students – both in their professional development and technical mastery of the subject matter. The Department of Chemical and Life Science Engineering is very grateful for the partnership opportunity."

The ongoing partnership allows students to become familiar with the industry and gives ChemTreat an opportunity to interact with, impact and prepare the next generation of chemical engineers with industry-specific, practical content.

Scan to learn more about Chemical & Life Science Engineering at VCU.